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Ground Water Currents

Developments in innovative ground water treatment

TECHNOLOGY

Optimizing Air Sparging Systems

by Harley Hopkins, API

The American Petroleum Institute (API) is currently funding a multi-university team to evaluate a suite of tracer tests that may provide more definitive real-time information on the performance of an air sparging system. API represents over 350 companies involved in oil and gas exploration, production, transportation, refining, and marketing. API's Soil and Ground Water Technical Task Force has been researching innovative in situ approaches to remediate soil and ground water for over 10 years.

Air sparging is being applied at a large number of sites with petroleum-contaminated ground water. The new tests may offer a way to evaluate air sparging system performance with fewer trial-and-error adjustments to air flow rates and sparge well placement, and provide clearer data than conventional techniques, such as monitoring dissolved oxygen. One test involves injecting a multi-compound tracer into a sparged aquifer. The tracer contains a solution of compounds that varies in volatility and biodegradability. After a period of time, the solution is withdrawn, and changes in compound concentration are measured. These data are used in models to estimate volatilization, oxygenation, and biodegradation rates. Laboratory tests of the tracers are nearing completion. Future field studies at federal and private sites will evaluate the viability and practicality of the tracer tests.

API also is studying natural attenuation, which is being used as a remediation technology at thousands of leaking underground storage tank sites in the U.S. Ground water at these sites is contaminated with benzene, toluene, ethylebenzene, and xylenes (BTEX). At new release sites, where it is not possible to make direct observations of BTEX mass or concentration reduction, ground-water samples can be analyzed for geochemical indicators of natural biodegradation. Sampling methods include conventional purge and bail, no purging, and micropurging.

Analytical methods are being studied for a number of geochemical parameters, including dissolved oxygen, nitrate, sulfate, ferrous iron, methane, carbon dioxide, alkalinity, oxidation reduction potential, pH, conductance, and temperature. The methods under study vary in accuracy, level of effort, and cost. The best method for a given application depends on project and site-specific considerations, particularly the specific manner in which data are to be used.

API expects to publish two reports this spring on measuring indicators of intrinsic bioremediation. One evaluates sampling and analysis methods; the other describes application, advantages, and disadvantages of various sampling and analysis techniques. For more information, contact Harley Hopkins (API) at 202-682-8318 or e-mail hopkins@api.org. A list and description of API soil and ground-water reports can be obtained on API's World Wide Web site at www.api.org/cat.

Containment Conference Held

Participants in the February 1997 International Containment Technology Conference and Exhibition in St. Petersburg, FL, discussed new methods for ground-water characterization and remediation. Success has been found in combining remediation systems, such as directional drilling combined with jet grouting, and geomembranes combined with drains or

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About this Issue

This issue highlights ongoing research and demonstration projects. These efforts focus on a number of technologies and methods, including air sparging, reactive walls, natural attenuation, and use of surfactants.

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Containment Conference

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soil- or cement-based barrier materials. New applications of existing technologies, such as hydraulic fracturing and multipoint injection, also were discussed.

Technical papers presented on the use of permeable reactive walls confirm that this technology has moved from the demonstration stage of development to the field application stage. In contrast, participants recognized that evaluation of performance assessment has not advanced significantly. Opportunities for technology improvement include developing effective methods for determining *in situ* hydraulic conductivity of barrier materials, enhancing quality assurance/quality control practices, developing techniques for sealing vertical barriers into aquicludes, and improving diffusion of organics through geomembranes. Participants also discussed the need for increased collection of performance data. Overall preference for risk-based corrective action was recognized as a significant factor in the continued selection of innovative methods of containment as a viable remediation technology.

Conference proceedings will be available in the late summer from Florida State University's Conference Coordinator at 904-644-5524 or e-mail ICTCE@mailer.fsu.edu.

Reactive Walls Demonstrated

by Richard Muza, EPA Region 8

Solvents are common contaminants in ground water at many Superfund sites and are particularly prevalent in ground water at military facilities. To demonstrate the applicability of iron reactive walls for ground-water remediation at U.S. Air Force facilities nation-wide, a zero-valent iron reactive wall was installed at Lowry Air Force Base, CO. The technology involves use of a subsurface wall of iron filings through which the contaminant plume migrates under natural ground-water flow. Chlorinated organics are degraded *in situ* through a reductive dechlorination reaction involving the zero-valent iron.

At Lowry, trichloroethylene was detected in alluvial ground water at a maximum concentration of 1,260 ppb, with related chlorinated organics present at lower concentrations. Monitoring results indicated that all of the chlorinated species degraded rapidly within the wall to concentrations below their detection limits, resulting in the formation of ethene, ethane, and methane. Field degradation rates for the major chlorinated organics were determined from the performance monitoring data and compared well to the results of other field demonstrations of this technology. Monitoring results indicated that changes with distance within the wall were consistent with the laboratory treatability study and other *in situ* reactive wall installations.

Anion-cation distributions in ground water were used to estimate theoretical porosity losses in the reactive wall due to carbonate and hydroxide precipitate formation. Results showed an estimated potential porosity loss of 13 to 14 percent per year. Cost comparisons of the reactive wall verses air sparging and pump-and-treat indicated that a reactive wall becomes the most cost-effective remedy after five to eight years.

The U.S. Air Force Center for Environmental Excellence, Colorado Department of Public Health and Environment, and EPA jointly concluded that the demonstration was highly successful. For more information, contact Richard Muza (EPA Region 8) at 303-312-6595.

Natural Attenuation Demonstrated

A recent demonstration at the Ohio River Park Site on Nevelle Island, PA, indicates that natural attenuation, coupled with source capping, should prevent migration of hazardous substances resulting from coke waste product disposed in on-site trenches. Ground water at the demonstration site is drawn from the same aquifer used by a municipal well field for the nearby town of Coraopolis's drinking water. The contaminant plume has been determined to flow as close as 1,000 feet from the well field.

Performance conclusions were based on the existing distribution of benzene and 2,4,6-trichlorophenol within the plume, which also contains natural attenuation metabolic by-products, including elevated concentrations of methane, iron II, and manganese II. A site-specific fate and transport model, which was independently verified by EPA models, predicts the effectiveness of natural attenuation at this location. Extensive research is underway to determine the location of three or more long-term monitoring wells, and additional data will be collected to confirm and ensure effectiveness of the process. This demonstration represents one of the first applications of natural attenuation on plumes associated with coal tar waste. For more detailed information, contact Romuald A. Roman (EPA Region 3) at 215-566-3212.

Calendar

Eighth Annual Western Governors Association/Weapons Complex Monitor Applied Research and Cleanup Technology Colloquium; Weapons Complex Waste Management and Cleanup: A "Corporate" Appraisal of the Investment in Cleanup Technology; April 29-May 2, 1997; Radisson Executive Conference Center, Scottsdale, AZ; 847-234-2353 or e-mail excpub@aol.com.

DOE's Environmental Cleanup: New Ways of Doing Business; Sponsored by McGraw-Hill Companies Inside Energy; May 12-13, 1997; Hyatt-Regency, Washington, D.C.; 800-223-6180 or 212-512-6410.

Air and Waste Management Association's 90th Annual Meeting & Exhibition; Science and Technology: the International Language; June 8-13, 1997; Metro Toronto Convention Centre, Toronto, Canada; 412-232-3444 or e-mail krau@awma.org.

Emerging Technologies in Hazardous Waste Management (Enviro Expo 97); Sponsored by the American Chemical Society, Division of Industrial and Engineering Chemistry; September 15-17, 1997; Pittsburgh Hilton and Towers, Pittsburgh, PA; 404-894-2856, e-mail daniel.tedder@che.gatech.edu, or Internet http://www.chemse.gatech.edu/~iec/Enviro.html.

Annual Meeting of the American Society of Chemical Engineers; November 16-21, 1997; Westin Bonaventure and Omni Los Angeles, Los Angeles, CA; 800-AIChemE, e-mail xpress@aiche.org, or World Wide Web at http://www1.che.ufl.edu/meeting/1997/annual/.

Resources

Technology Practices Manual To Be Released

The first edition of an innovative technology practices manual for surfactants and co-solvents will be released this month. Rice University, which has conducted extensive research on surfactants, is preparing the manual under a grant from the Advanced Applied Technology Demonstration Facility at the U.S. Department of Defense. For more information, contact Donald F. Lowe, Ph.D. (Rice University) at 713-527-4725.

DNAPL Remediation Report Issued

Researchers at the University of Oklahoma studied the inefficiency of conventional pump-and-treat methods for removing dense nonaqueous phase liquids (DNAPLs) and identified surfactants as a promising technology. Researchers also examined regulatory approval and economics, which are considered the primary obstacles to widespread implementation of surfactant-enhanced subsurface remediation. Results of their studies are described in the environmental research brief, Surfactant-Enhanced DNAPL Remediation: Surfactant Selection, Hydraulic Efficiency, and Economic Factors (EPA/600/S-96/002). To order, contact EPA's Robert S. Kerr Environmental Research Center at 405-436-8651.

NAPL Demonstration Review Planned

Major stakeholders in the field of surfactant-enhanced remediation will meet May 7-8 at Hill Air Force Base, UT, to review current and planned *in situ* flushing activities. The performance of recent demonstrations suggests that removal of nonaqueous phase liquids (NAPLs) is possible through *in situ* flushing. Additional information may be obtained from A. Lynn Wood (EPA National Risk Management Research Laboratory) at 405-436-8552 or Steven Shoemaker (DuPont) at 281-586-2513.

Conference Scheduled on Advances in Innovative Ground Water Remediation Technologies

The Ground Water Remediation Technologies Analysis Center (GWRTAC), with support from the EPA's Technology Innovation Office, is sponsoring the "Advances in Innovative Groundwater Remediation Technologies Conference." The conference will be held on July 31, 1997, in Philadelphia, PA, at the Warwick Hotel. The conference will focus on recent developments in, and a range of, innovative *in situ* ground-water remediation technologies that are being developed and applied throughout the U.S.

There is no registration fee; however, advance registration is required. The conference is open to ground-water remediation professionals from the government, research and development, university, and consulting/remediation sectors. For additional information, contact GWRTAC at either (800) 373-1973, e-mail gwrtac@netac.org, or visit the World Wide Web site at http://www.gwrtac.org.

Regulators Review Surfactant Injection

Interviews with eight state regulatory authorities were conducted to document their experiences with reviewing applications or proposals to inject surfactants into contaminated ground water. The interviews include discussions of barriers to application acceptance and mistakes applicants made in filing applications. The resulting report, Surfactant Injection for Ground-Water Remediation: State Regulators Perspectives and Experiences (EPA 542-R-95-011), may be downloaded from the Clean-Up Information (CLU-IN) site on the World Wide Web (http://clu-in.com).

Fractured Rock Guidance Issued

A field site was developed and studied in the Sierra Nevada, CA, foothills to test a multi-disciplinary approach to the characterization of ground-water flow and transport in fractured rocks. The study was conducted at the Raymond Field Site, which is operated by the U.S. Department of Energy's Lawrence Berkeley National Laboratory and the U.S. Geological Survey. Project sponsors also included Atomic Energy of Canada, Ltd., and U.S. EPA. Key findings of the project are described in a project summary, "Hydrogeologic Characterization of Fractured Rock Formations: A Guide for Groundwater Remediators" (EPA/600/S-96/001) published by EPA's National Risk Management Research Laboratory (NRMRL). The project summary is available from NRMRL at 405-436-8651. The U.S. Department of Energy (DOE) has prepared the companion project report, "Hydrogeologic Characterization of Fractured Rock Formations: A Guide for Groundwater Remediators" (DOE report number LBL-38142/UC-800), that compares tools and methodologies for characterizing ground-water movement in fractured rocks and provides suggestions for analyzing and integrating relevant data. Contact the National Technical Information Service (NTIS) at 800-553-6847 to obtain copies of the complete project report (NTIS order number DE96009137).

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